Storage and use of sodium chlorate and other similar strong oxidants

Guidance Note CS3

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ISBN 978 0 7176 1500 1
Price £4.50

This guidance has been produced to help duty holders to ensure the safe storage and use of sodium chlorate and other similar strong oxidants.

First published 1980
Second edition 1983
Third edition 1985
Fourth edition 1998

ISBN 978 0 7176 1500 1

This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

Contents

Introduction

1 The Health and Safety at Work etc Act 1974 imposes general duties to ensure that workers and others are protected against risks to their health and safety from work activities. This guidance has been produced to help duty holders to ensure the safe storage and use of sodium chlorate and other similar strong oxidants. In Great Britain the main use of sodium chlorate is as a weed killer. It is also used as a bleaching agent and as an intermediate in the manufacture of perchlorates.

2 Sodium chlorate is a slightly hygroscopic colourless crystalline solid which has a melting point of 248°C. It is readily soluble in water. Sodium chlorate is relatively stable and decomposes at approximately 265°C with the liberation of oxygen and heat.

3 Other chlorate chemicals (eg potassium chlorate, calcium chlorate, barium chlorate) , and chemicals such as bromates, chlorites, perchlorates, etc, are similar to sodium chlorate in their chemistry and the hazards they present. They should be regarded as similar strong oxidants and need to be treated in a same way as sodium chlorate. Chlorites require specific mention as very strong oxidising agents which may cause a spontaneous ignition if allowed to impregnate wood (such as a pallet) which subsequently dries.

Hazards

4 Although sodium chlorate will not burn when heated in a fire, it can decompose and release oxygen, increasing the flame temperature and the speed of burning. There have been a number of incidents in warehouses where sodium chlorate has been involved in fires resulting in violent explosions, some of which have caused considerable damage to the warehouse and adjacent buildinqs. [1]

5 Sodium chlorate may decompose rapidly if it is mixed with different chemical substances or comes into contact with them. It is an oxidising agent and when mixed with materials such as fuels and other organic materials it is capable of ignition by relatively mild friction or impact, and may burn and explode. In particular, sodium chlorate should not be mixed with substances such as sulphur and sulphur-containing chemicals, ammonium salts (eg ammonium nitrate), amines, phosphorus, cyanides, acids, and powdered metals. Some of these materials form mixtures with sodium chlorate which may ignite spontaneously. Advice on the precautions to take when storing other chemicals in the same warehouse as these oxidants should be obtained from your chemical supplier.

Storage

6 Sodium chlorate should be stored in a secure area away from sources of ignition and flammable materials, and in such a way as to eliminate the possibility of contamination or it becoming involved in any fire. It should be kept apart from food, drink and animal feedstuffs. It may be stored with other similar strong oxidants providing they are not incompatible (see paragraph 5).

7 Sodium chlorate should be stored isolated from incompatible materials in a dedicated store, either in the open on a concrete pad, with or without a roof, or preferably fully enclosed. The risks of damage to the packaging and the caking of the sodium chlorate from exposure to rain are reduced in an enclosed store.

Whether enclosed or not, observe the following:

- Any structure used must be constructed entirely of materials that will not burn, such as concrete, brick or steel.
- The floor of the chlorate store should consist of impervious non-combustible material and have a smooth surface.
- Limit stacks of chlorate to a maximum of 25 tonnes, to reduce the risk of detonation through self-confinement. To help prevent fire spread, keep a 3 m gap or a thermal barrier (such as a brick wall) between stacks of chlorate.
- Prohibit smoking, the use of naked flames, and the introduction of any combustible materials in the storage area, and display No Smoking notices at the entrance to the store.

8 Keep stacks of sodium chlorate separated by either a distance of at least 10 m or a substantial thermal barrier (double brick wall or equivalent) from:

- combustible materials (including vegetation such as grass or brambles);
- occupied factory buildings and any place in the factory which may contain combustible materials;
- the boundary of the factory premises.

Packaging

9 It is preferable to package chlorates in metal drums which contain a plastic liner (or other means) to prevent the corrosion caused by chlorate/metal contact. Metal drums are robust, and provide an inherently safe place of storage by minimising the amount of combustible material present. However, international transport agreements (eg International Maritime Organisation (IMO) and *Accord europeen relatit au transport international de merchandises dangereuses par route* (ADR)) authorise the use of certain soft packaging materials, eg flexible intermediate bulk containers (IBCs) or plastic-lined paper bags which are shrinkfoil wrapped and strapped onto wooden pallets. Although such packagings introduce combustible components, they can be accepted provided that they meet the international specifications for such packaging, and that the recommendations of this guidance note are strictly followed.

10 Wooden pallets should not be used for the routine storage of chlorates since, in addition to being a combustible material, they may, with continued use, become impregnated with chlorate and thereby themselves become a considerable fire risk and also a potential source of ignition. However, when the pallets form an integral part of an International Maritime Dangerous Goods (IMDG) Code approved package, in which the chlorate bags are totally enclosed by a shrinkfoil wrapping and the wood is new and uncontaminated, they may be allowed for one-off storage only. Any wooden pallets which are suspected of being contaminated with chlorate can be destroyed by burning under controlled conditions in an isolated area.

11 Wash empty chlorate containers with water and keep them in the dedicated store or storage area in a place set apart for this purpose. Contaminated drums should not be allowed to accumulate.

12 The contents of damaged or leaking containers will need to be transferred immediately to clean, undamaged metal containers, taking care to avoid contamination. Spilled or contaminated sodium chlorate should be disposed of in accordance with the manufacturer's instructions. In case of doubt, any recovered spillage material will need to be treated as being contaminated.

Use

13 Ensure that the quantity of sodium chlorate kept in the workplace during processing or other operations is as small as reasonably practicable, and not more than one day's supply.

14 Blending and milling with inert materials to suppress the risk presented by sodium chlorate is best carried out by the addition of the sodium chlorate to the suppressant rather than the converse.

15 Combustible materials such as wood, paper and rags should not be present in the process area. Particular attention should be given to the prevention of seepages of grease from bearings and gear boxes of electrical motors. Electrical equipment, including motors, should be constructed or protected, or suitably positioned, so as not to allow the entry of chlorate dust.

16 Positive extraction via metal trunking, discharging through water scrubbers, will need to be provided in areas where fine dust might arise. Operators engaged in processing sodium chlorate should be provided with clothing which is flame-resistant and non-absorbent and this should be changed and laundered regularly. Gloves and footwear should be made of rubber or other suitable material, and any tools or implements should preferably be of non-sparking metal and should be washed frequently.

17 Keep working areas scrupulously clean and change contaminated clothing immediately.

Fire-Fighting

18 Water is the only agent which is effective in fighting fires that involve sodium chlorate, preferably applied as a spray to avoid spreading the material. A sufficient supply of water commensurate with the amount of sodium chlorate and possible flammable materials in the vicinity should be provided. Sprinkler systems may be required in process areas handling sodium chlorate. Since there is the possibility of an explosion occurring in fires involving sodium chlorate, the fire brigade should be informed of the areas of the site where storage or processing of the chlorate are being carried out. Advice on the control of fire water run-off is given in the HSE publication EH70. [2]

19 As metallic chlorates do not themselves burn, it may not be necessary to install sprinkler systems in properly designed storage places which meet the requirements described in this guidance note.

Security

20 Several explosions involving chlorates have been caused by intruders or vandals deliberately starting fires. Storage places for sodium chlorate and other strong oxidants may require appropriate security provisions, particularly during silent hours, to deter unlawful entry into the premises. The local police should be informed of the storage, and advice on security measures should be sought from crime prevention officers.

Fire-supressed sodium chlorate

21 Fire-suppressed sodium chlorate compositions consist of sodium chlorate blended with inert inorganic materials such as sodium chloride, sodium carbonate or borax, together with an anti-caking agent, and generally contain between 32% and 60% sodium chlorate. Although the oxidising potential and fire risk are considerably reduced, these compositions are still capable of forming explosive mixtures with certain organic compounds.

22 Small-scale storage and handling of fire-suppressed sodium chlorate may be considered to be outside the special provisions presented in this guidance note, provided that:

- the sodium chlorate is admixed with at least 32% of an acknowledged fire retardant (such as those mentioned in paragraph 21);
- it is packaged in suitable closed containers (ie smooth impervious pots) in quantities not exceeding 2 kg per container;
- the total quantity at the premises does not exceed 2 tonnes of fire-suppressed sodium chlorate;
- good housekeeping standards and sensible separation from incompatible materials are maintained.

23 For quantities of fire-suppressed sodium chlorate larger than those presented in paragraph 22, the conditions recommended for storage are less stringent in relation to the stack sizes and separation distances given in paragraphs 7 and 8. The quantity in the stack may be increased in proportion to the dilution so that the net sodium chlorate quantity does not exceed 25 tonnes, eg a fire-suppressed chlorate having 50% net sodium chlorate blended with other inert inorganic materials may be kept in stack sizes of 50 tonnes. Alternatively, the separation distances may be reduced in proportion to the dilution. However, the precautions with regard to incompatibility with other materials, particularly those of a combustible nature, are unchanged.

Summary

24 It is emphasised that there is no reason to treat pure chlorates as being intrinsically dangerous; they will not even burn. The dangers arise if:

- they are allowed to mix intimately with potential fuels, including materials such as paper, sawdust and sugars;
- they are stored in such a way that they can become exposed to vigorous external heating in a fire situation;
- they are allowed to mix with acids or certain other chemicals.

Other information

25 Information about the hazards and the packaging methods for sodium chlorates and other strong oxidising substances can be obtained from CHIP97 *Approved Supply List*. [3]

26 Premises where sodium chlorate is stored may be subject to the following Regulations, depending on the quantity stored:

- the Notification of Installations Handling Hazardous Substances Regulations 1982 (NIHHS); [4]
- the Control of Industrial Major Accident Hazards Regulations 1984 (CIMAH); [5]
- the Planning (Hazardous Substances) Regulations 1992 [6] or in Scotland, the Town and Country Planning (Hazardous Substances) (Scotland) Regulations 1993 (PHS). [7]

27 These Regulations contain requirements to notify the authorities of certain information. Depending on the quantity stored, CIMAH may require the preparation and updating of safety reports and the preparation of emergency plans. Table 1 shows the quantities of sodium chlorate and other oxidisers (in tonnes) at or above which these Regulations apply.

Table 1

Oxidant	*Application of NIHHS*	*Application of CIMAH regulation 4 for storage*	*Application of CIMAH regulations 7-12 for storage*	*Application of PHS*
Sodium chlorate	25	25	250	25
Other oxidisers	-	10	200	-

REFERENCES

1 *The fire and explosions at Band R Hauliers, Salford,* 25 September 1982 HSE Books 1983 ISBN 0 11 883702 8

2 *The control of fire water run-off from CIMAH sites to prevent environmental damage* EH70 HSE Books 1995 ISBN 0 7176 0990 1

3 *Approved supply list. Information approved for the classification and labelling of substances and preparations dangerous for supply (including supplement) CHIP* 96 and 97L76 (Third edition) HSE Books 1996/97 ISBN 0 717614123

4 *The Notification of Installations Handling Hazardous Substances Regulations* 1982 SI 1982/1357 HMSO ISBN 0 11 027357 5

5 *The Control of Industrial Major Accident Hazards Regulations* 1984 SI 1984/1902 HMSO ISBN 0 110479025

6 *Planning (Hazardous Substances) Regulations* 1992 SI 1992/656 HMSO ISBN 0 11 023656 4

7 *Town and Country Planning (Hazardous Substances) (Scotland) Regulations* 1993 SI 1993/323 HMSO ISBN 0 11 033323 3

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Further information

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Published by HSE 04/10